Flow and Benthic Ecology 4D - FLOWBEC - An overview

Flow & Benthic Ecology 4D (FLOWBEC)

Paul S. Bell & David McCann – National Oceanography Centre, Liverpool
Philippe Blondel - U.Bath
Angus Creech & David Ingram – U.Edinburgh
Dan Conley – U.Plymouth
Graham Savidge – Queens U. Belfast
Bob Kennedy, Jack O'Carroll National University of Ireland, Galway
Beth Scott, **James Waggitt & Benjamin Williamson** - U.Aberdeen
Lars Johanning & Ian Ashton – U. Exeter
Ricardo Torres & Pierre Cazenave – PML
Eric Armstrong & Chris Hall – Marine Scotland Science

Summary

Using developments in high resolution physical modelling and state of the art observation systems, we aim to identify the physical conditions influencing the behaviour of fish and their predators and also benthic communities by concurrently measuring hydrodynamics and biology at 3 different wet Marine Renewable Energy test sites.

Funding of £1.2M over 3 years – started September 2011

Progress:

- **Activities related to EMEC tide and wave sites**
- **Activities related to Wave Hub**
- **Activities related to Strangford Lough**

- **Application of FLOWBEC related techniques to commercial sites**

Activity at EMEC wave and tidal sites

At the surface:

- Marine Radar monitoring (currents, roughness, bird tracking)
- Bird Observations & linkages with measured and modelled hydrodynamics (James Waggitt's talk – combined work with RESPONSE)

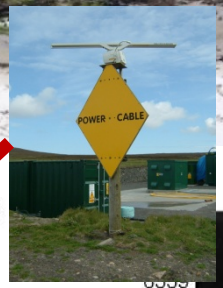
Under water:

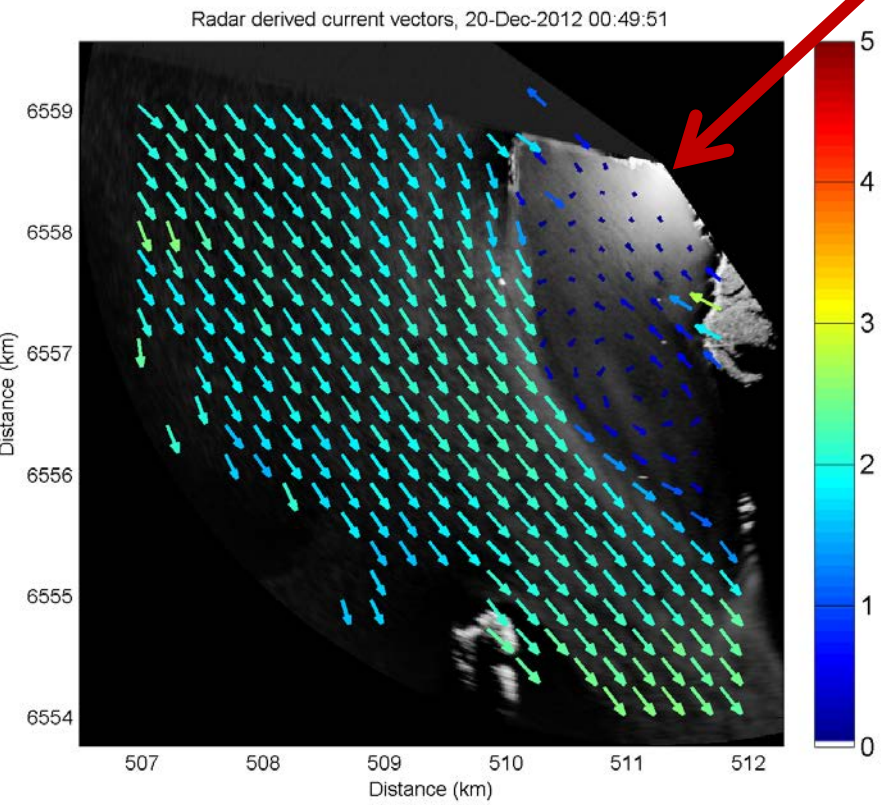
- 5 deployments of the FLOWBEC sonar frame

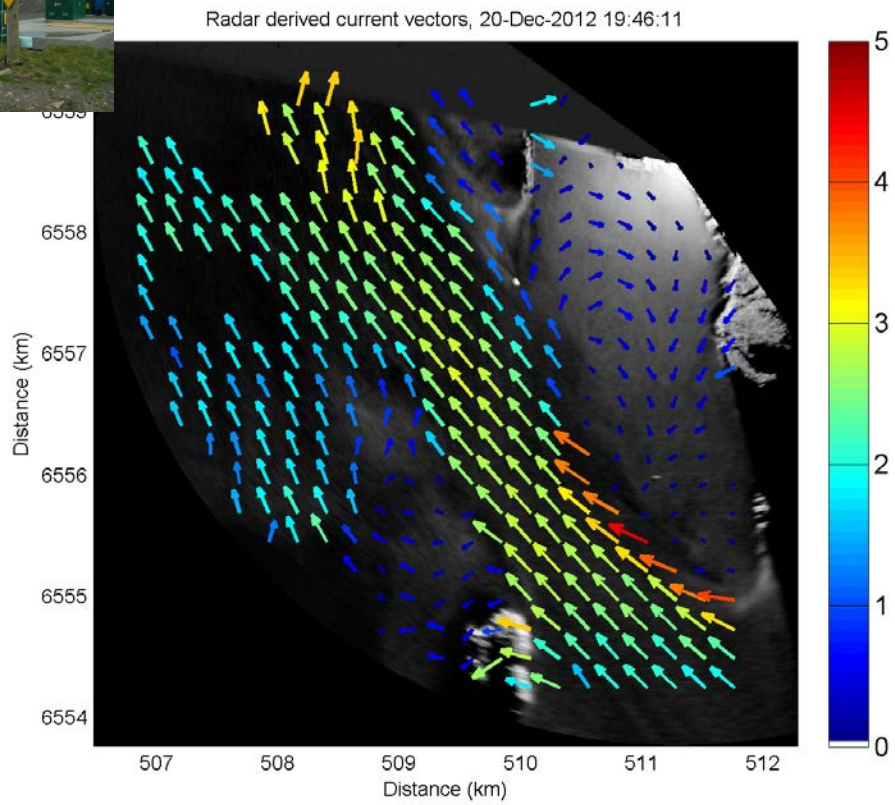
(Benjamin Williamson's talk)

FVCOM modelling (PML)

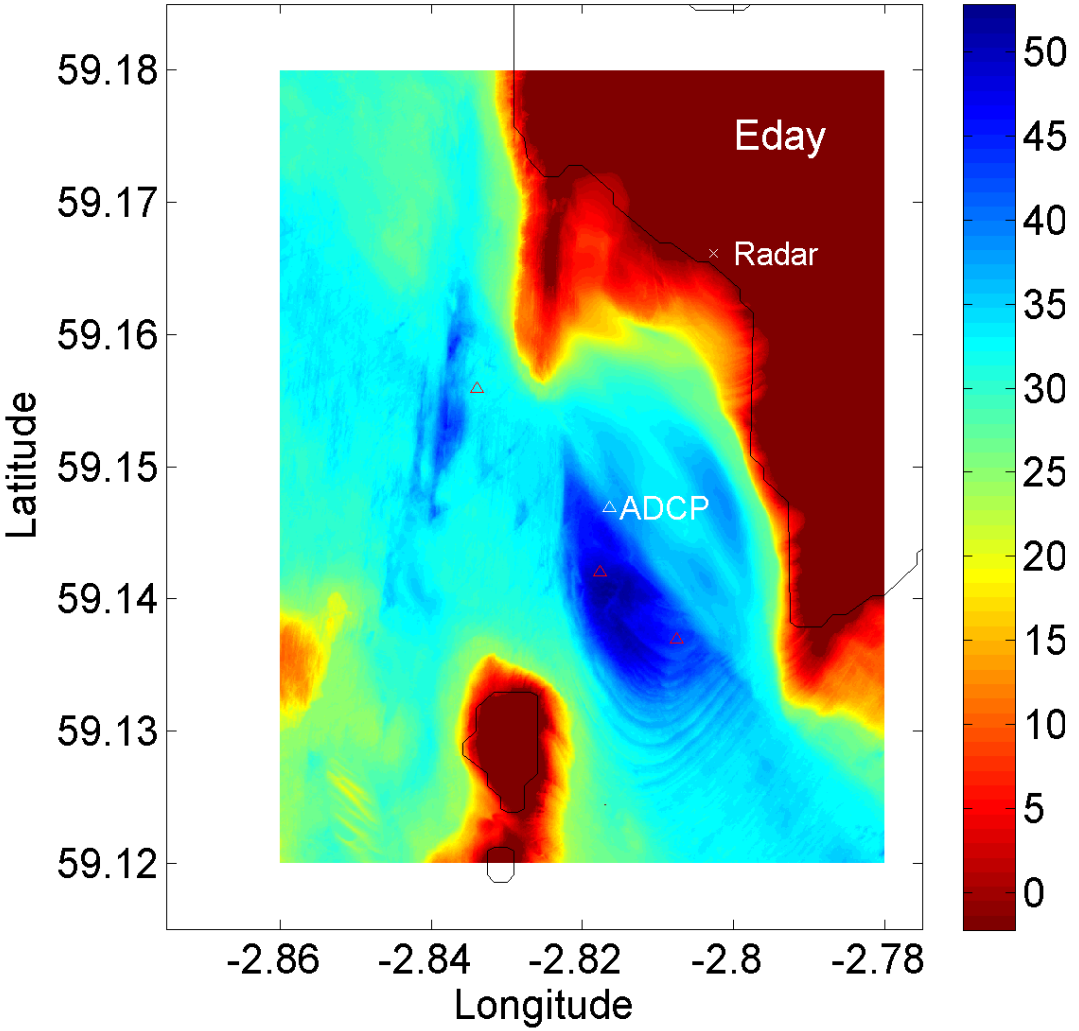
Radar Flood and Ebb Currents at EMEC tidal site

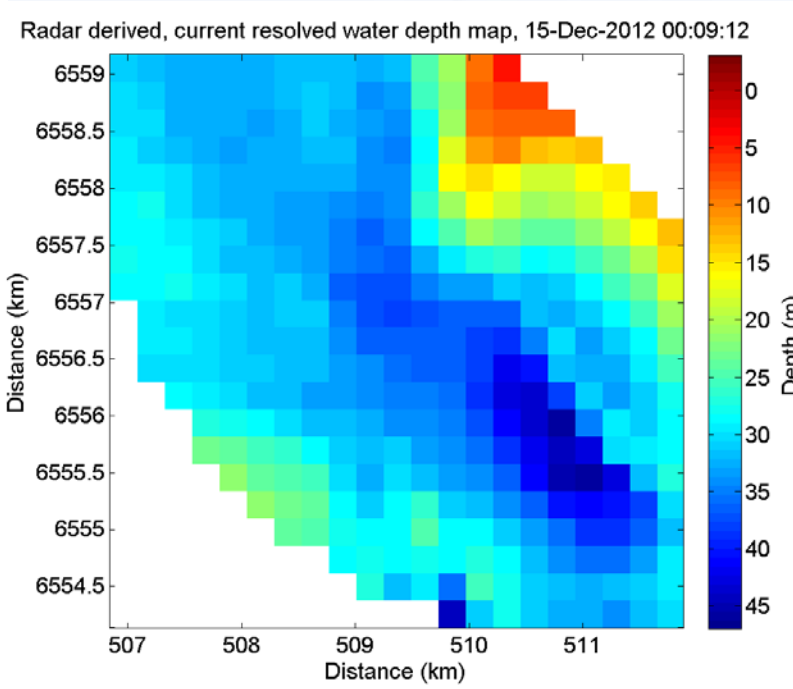




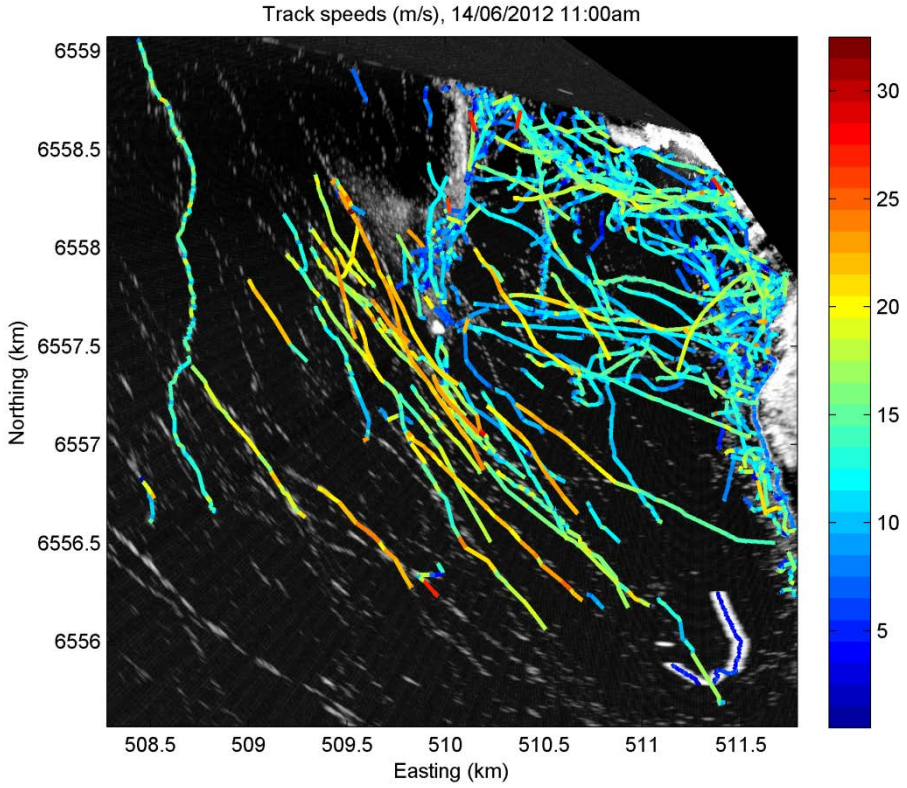


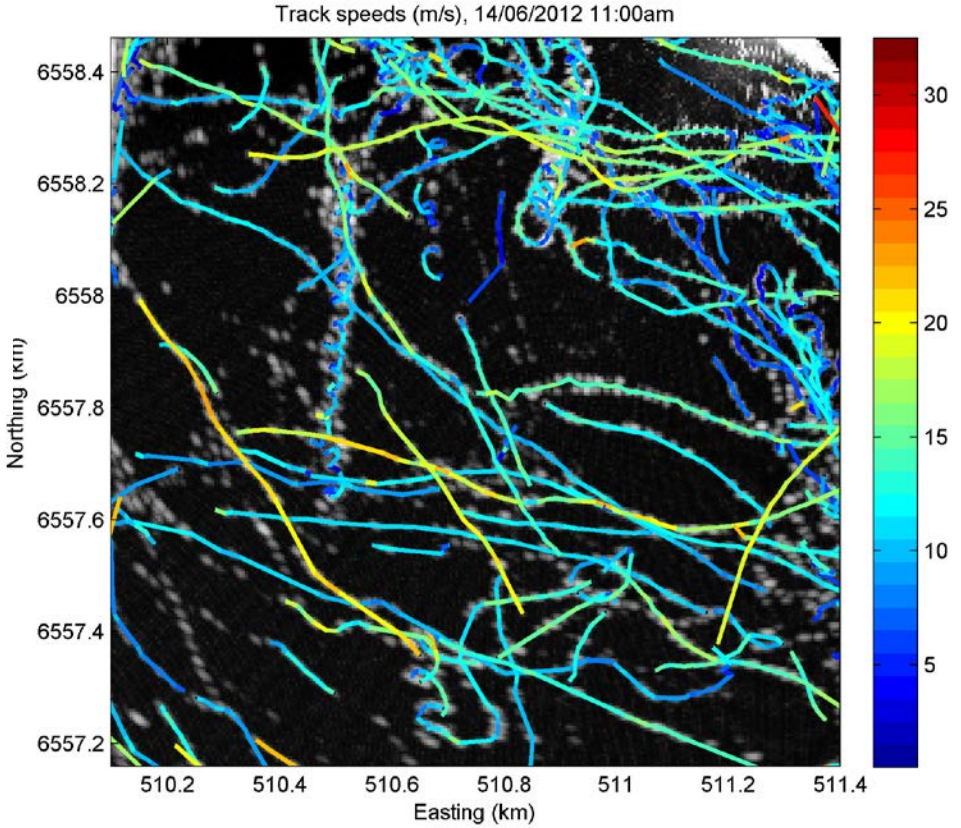
Survey & Radar derived bathymetry





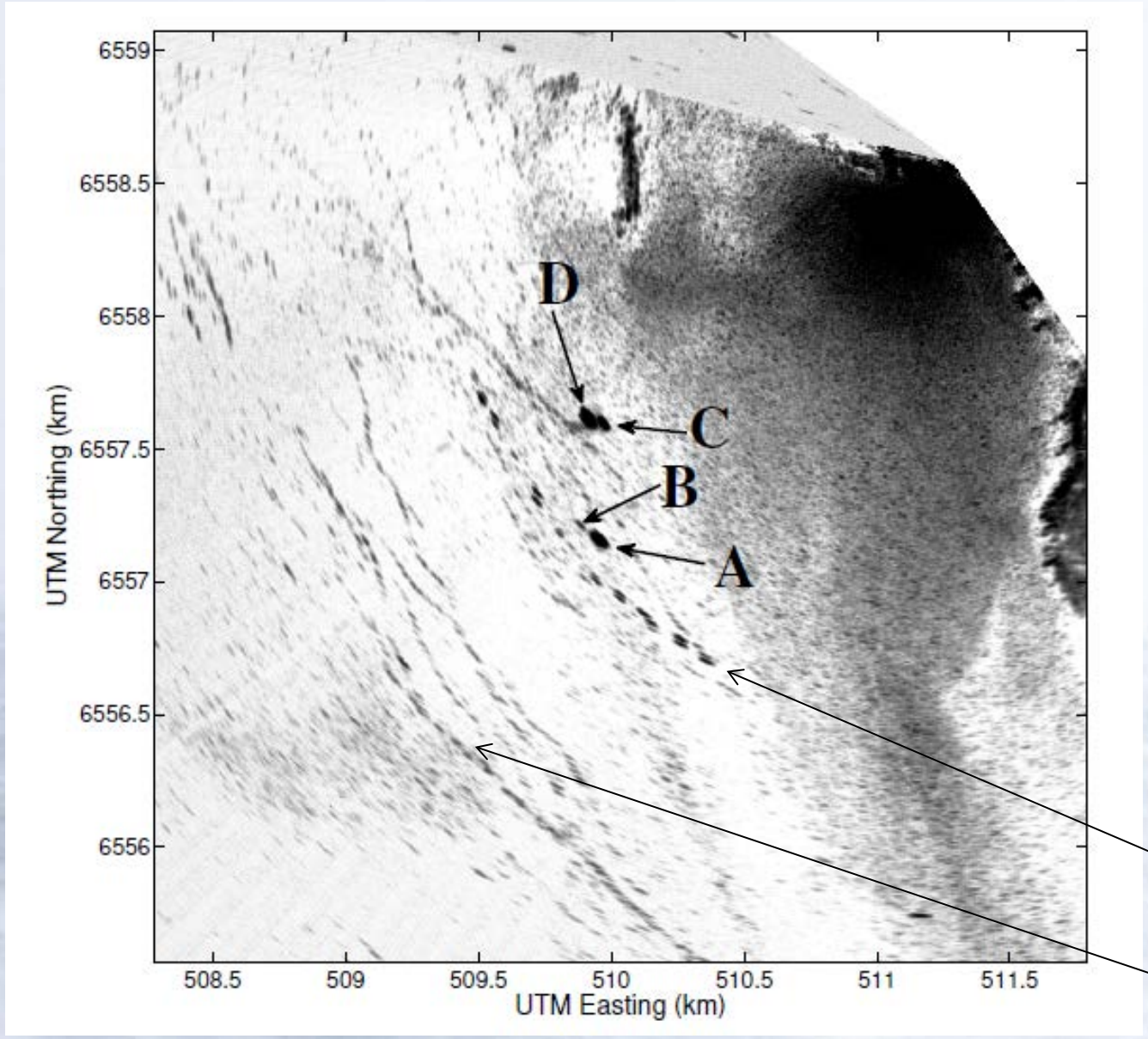
Small Target (Bird/Beastie) Tracking





Target tracks in a single five minute radar record
colour = speed (m/s)
Images by David McCann (NOC)

Confirmed Orca Tracks (breaching) captured on radar June 18th 2013



A: FLOWBEC frame deployment vessel

B: support vessel

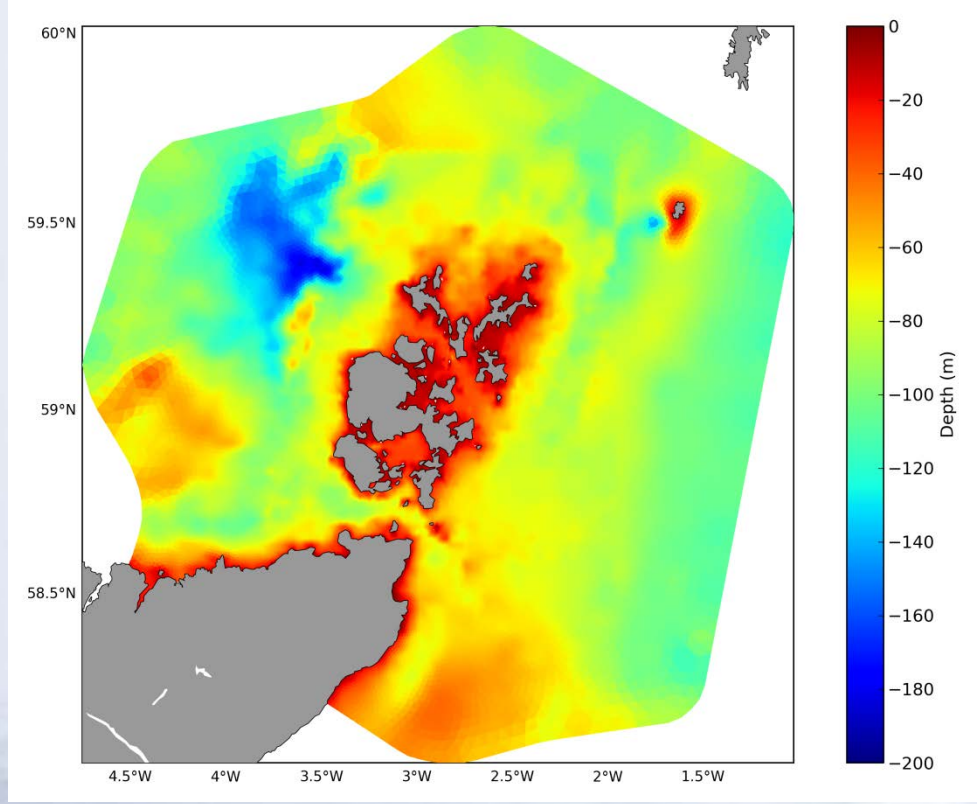
C: maintenance vessel

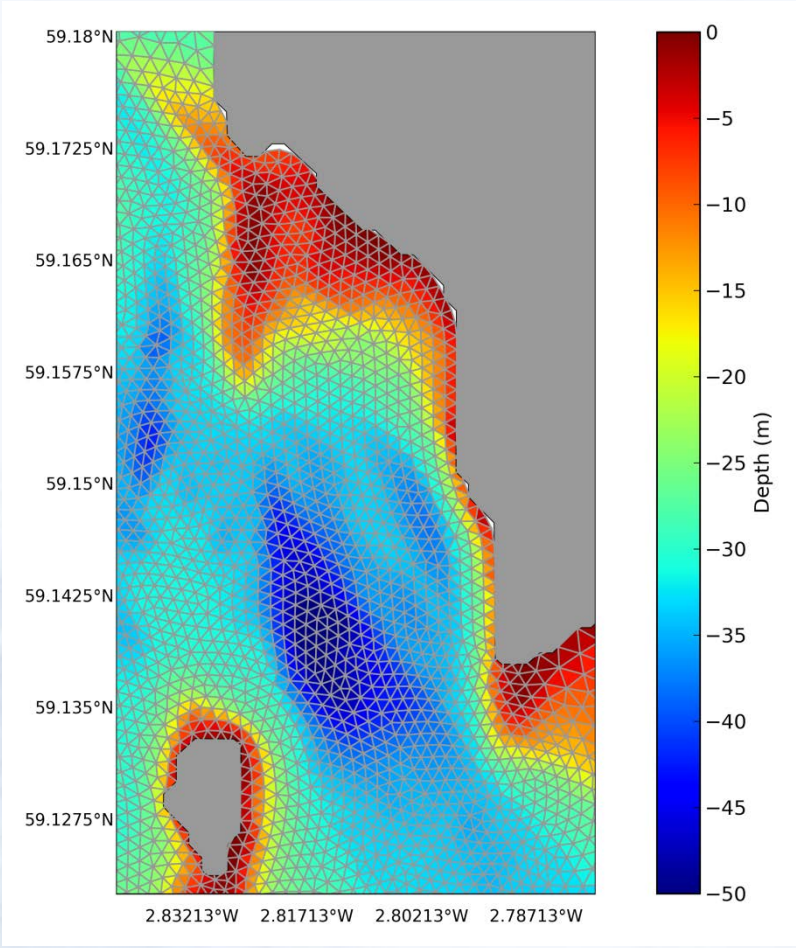
D: OpenHydro Test platform

Orca Tracks

Bird Tracks

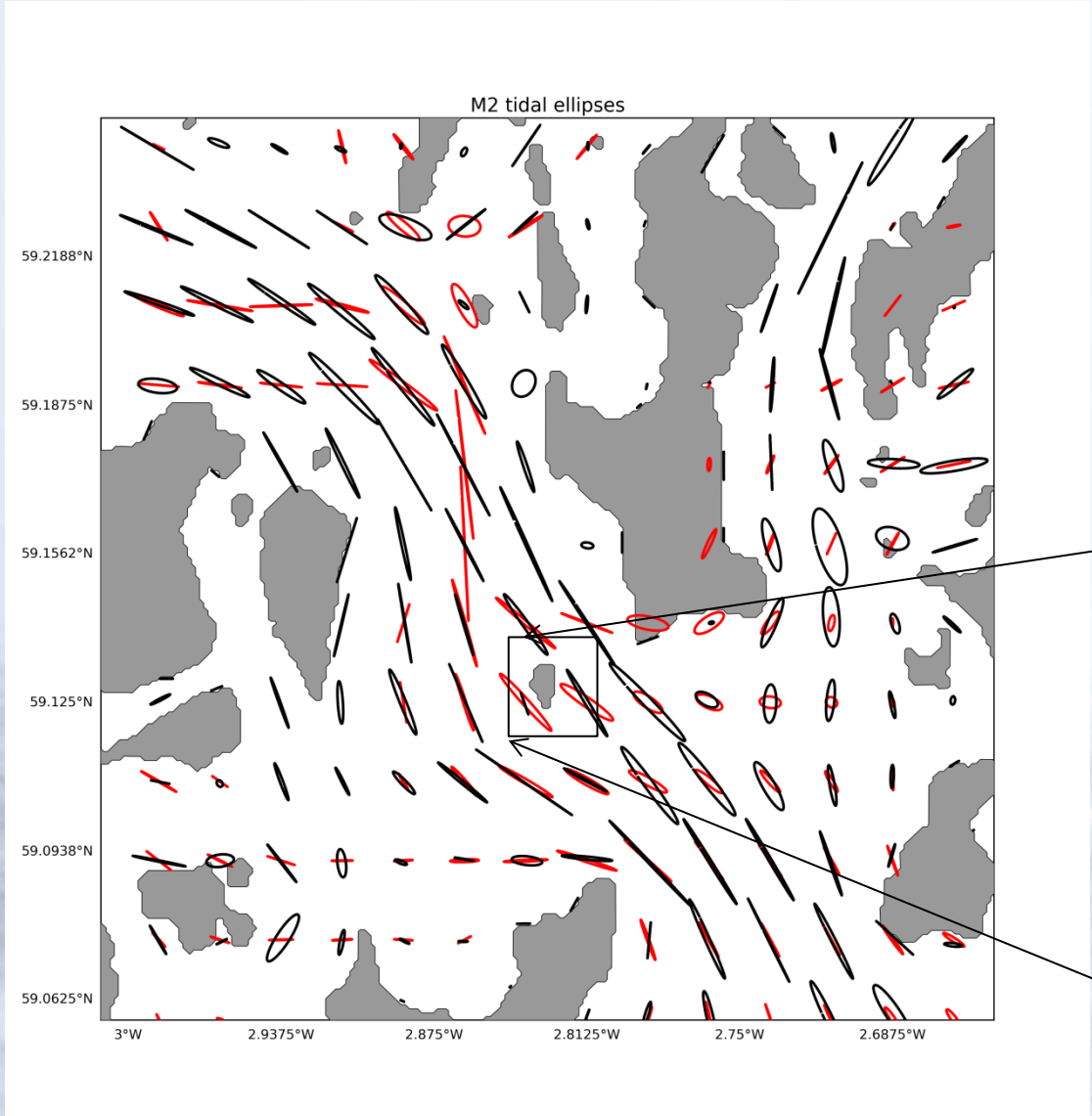
FVCOM modelling – Orkney area

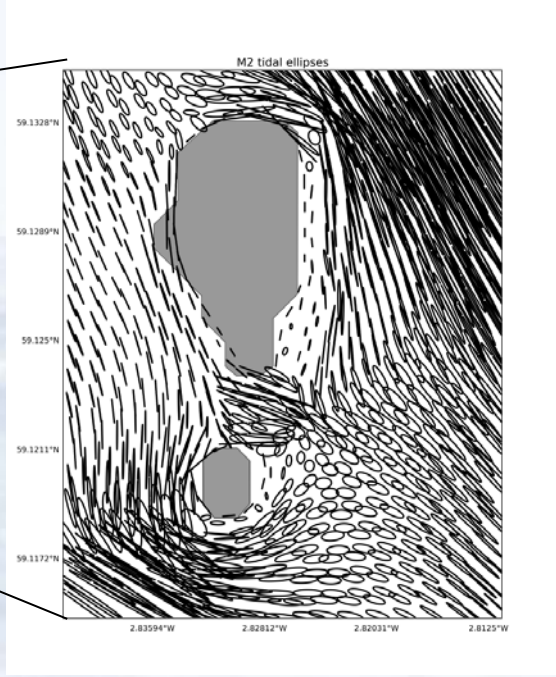




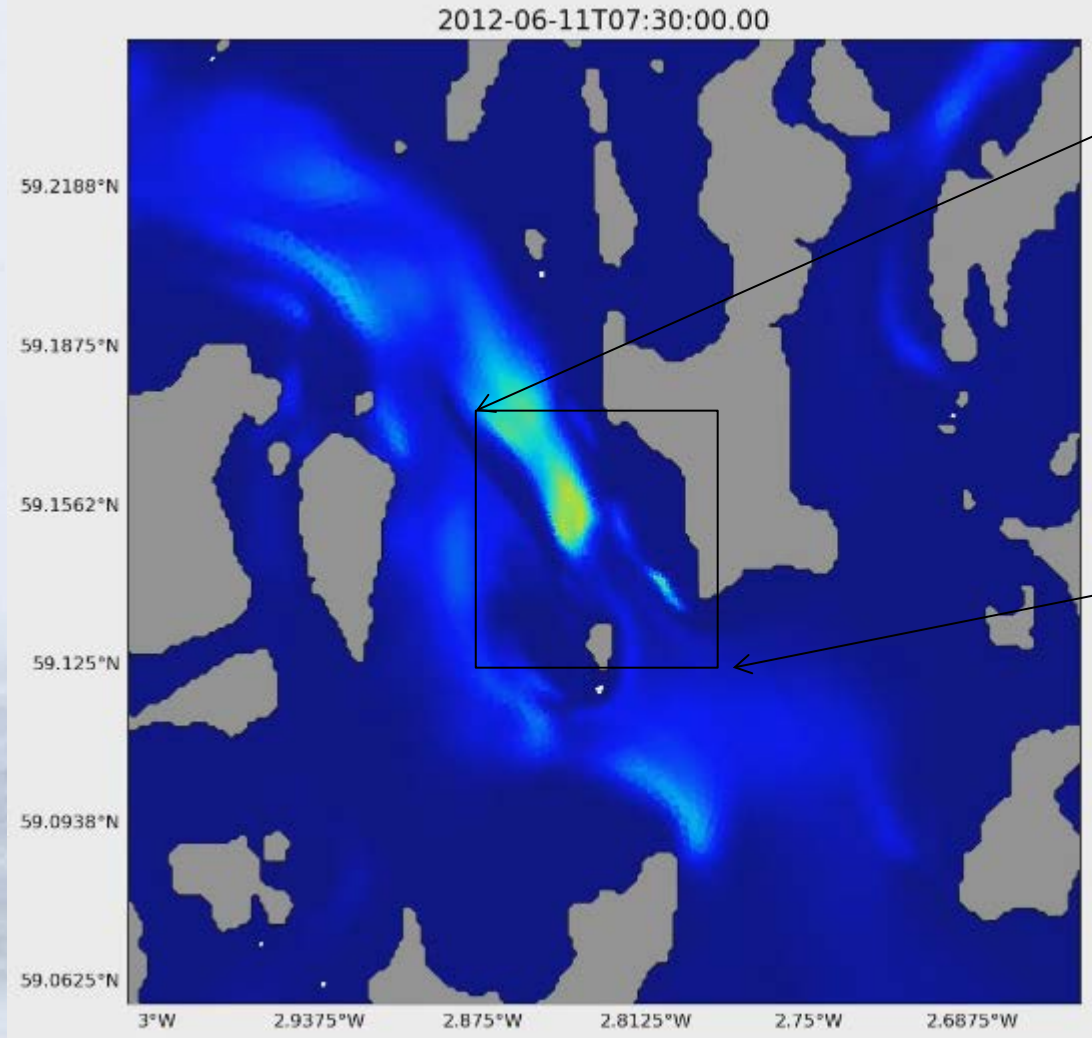
Images: Ricardo Torres & Pierre Cassenave, PML

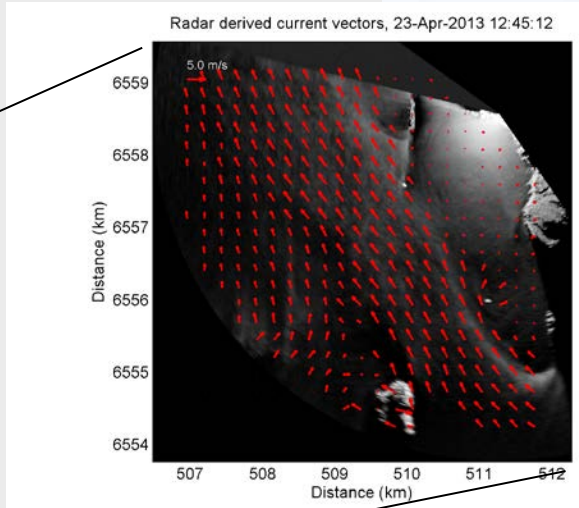
FVCOM M2 Ellipses (ORKM POLPRED in red)

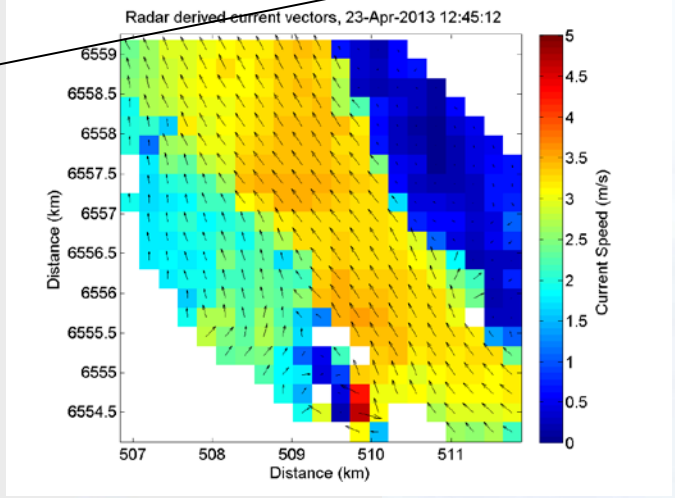




Investigating currents & turbulence







FVCOM – turbulence

Marine radar

Wave Hub

- In situ wave and current measurements – focussed on understanding spatial variability

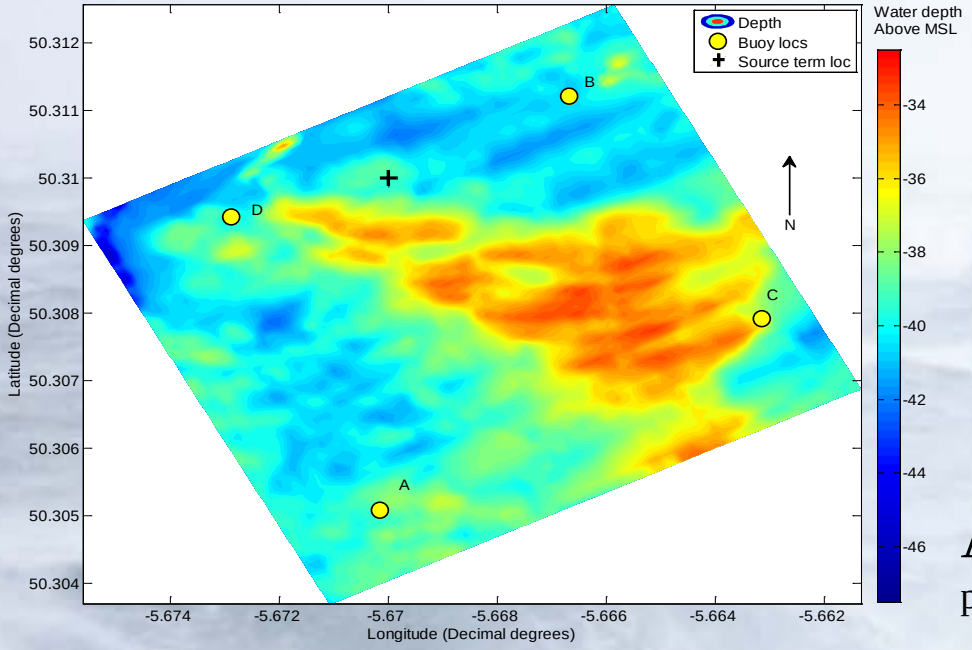
(Ian Ashton's Talk)

- HF Radar measurements of currents and wave height – spatial variability of wave height & currents
- FVCOM modelling of hydrodynamics – valiadation against various datasets

Arrays of wave measurements

High spatial variability in wave measurements from four wave buoys – not artefacts

~10% variation in wave power across 500m square area in open sea

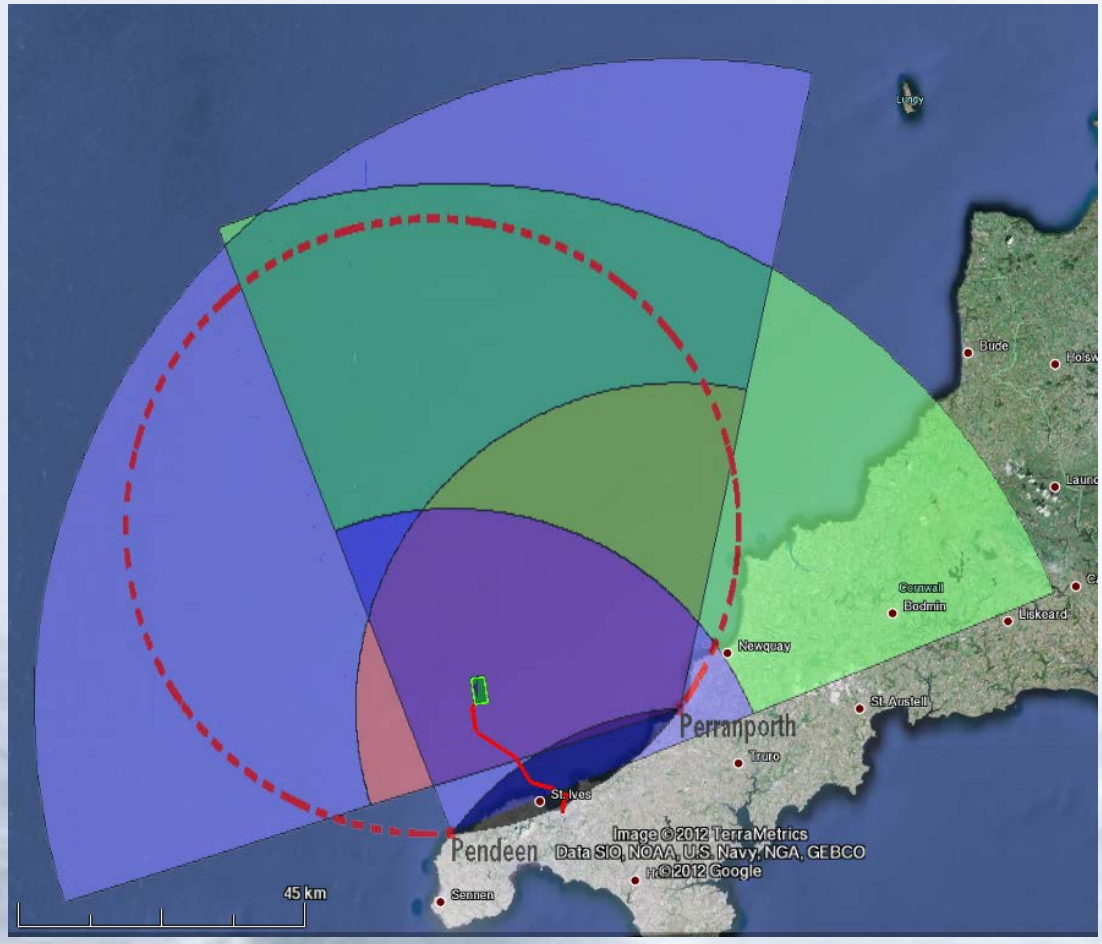


Wave buoy

Acoustic Doppler Current Profiler

picture from Ian Ashton – Exeter University

Wave Hub HF Radar Installation



- Work ongoing to improve empirical algorithms for wave height determination.
- Use of in-situ buoy measurements to develop a site specific correction.
- Progress in understanding the factors that can affect wave height measurements

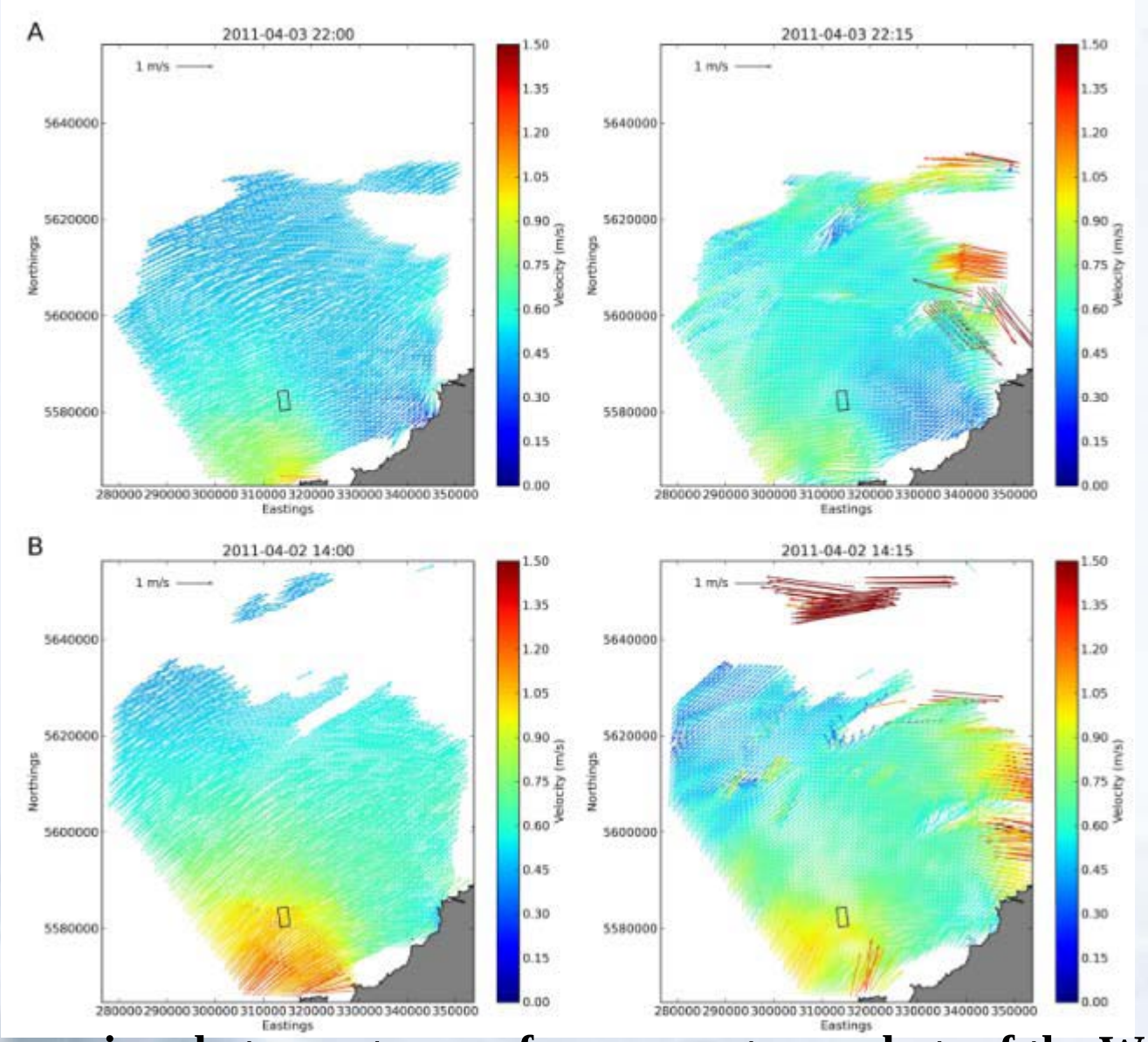
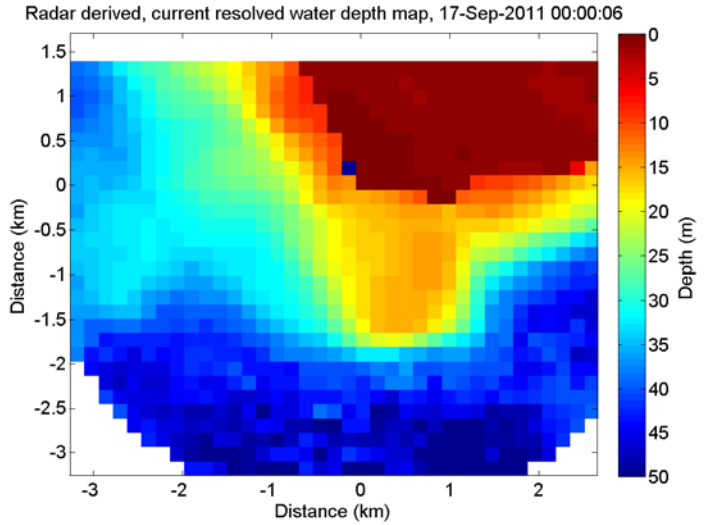
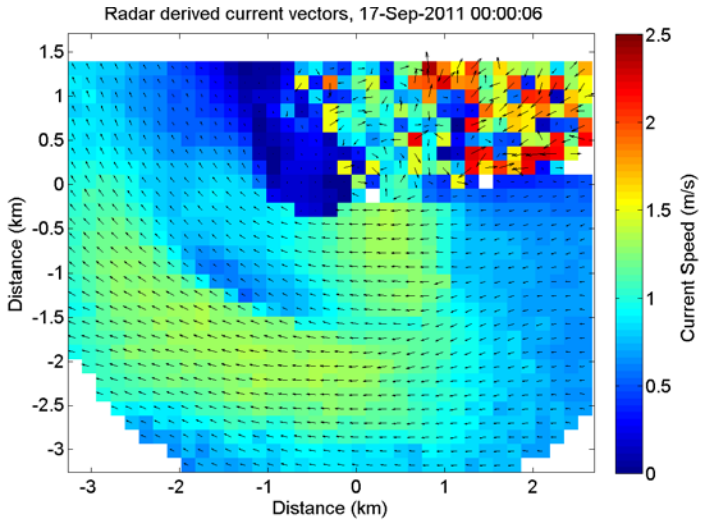


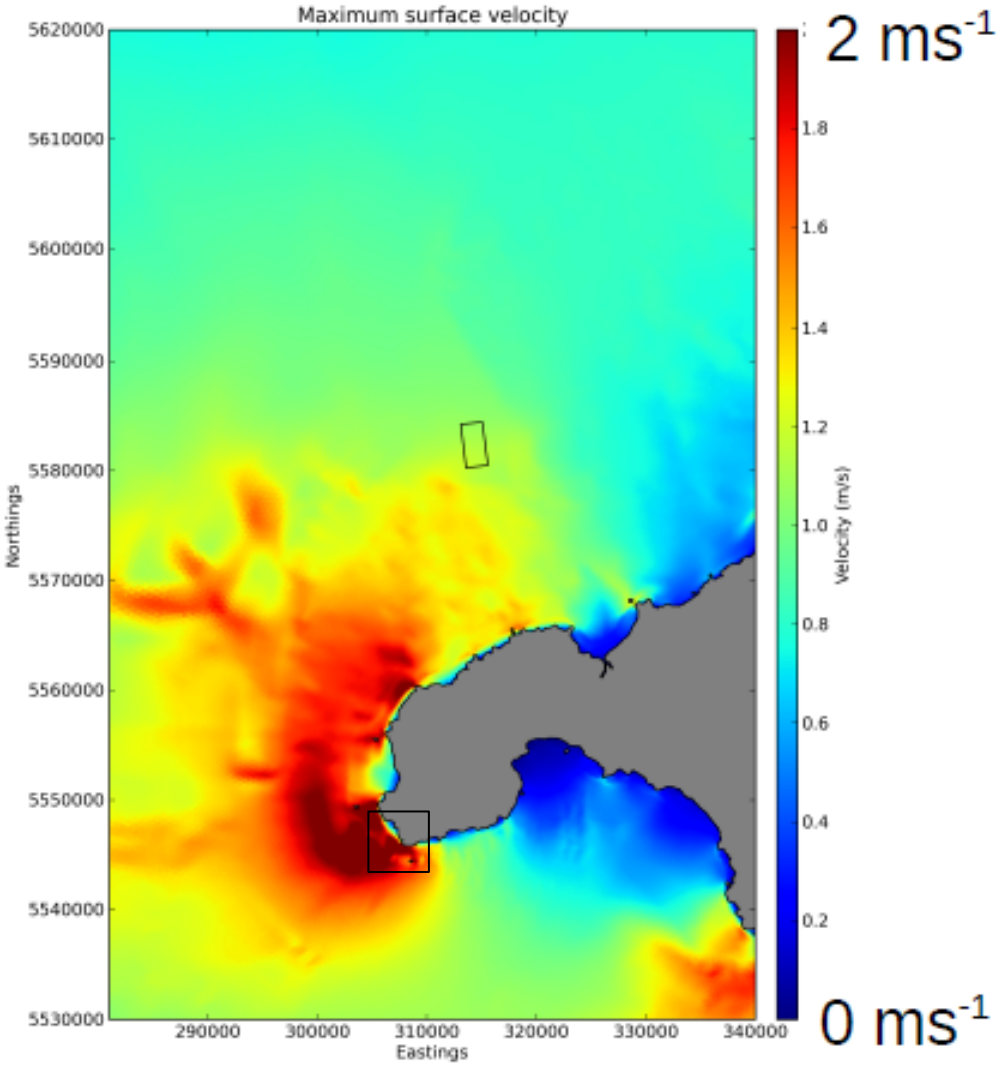
Figure 6. Comparison between two surface current snapshots of the Wave Hub region from the WERA HF radar (right) with FVCOM current predictions at the same times and locations (left). The colour scale indicates current speed, and the box represents the Wave Hub site.

Planned comparison of FVCOM currents with earlier radar data

WaveHub surface currents





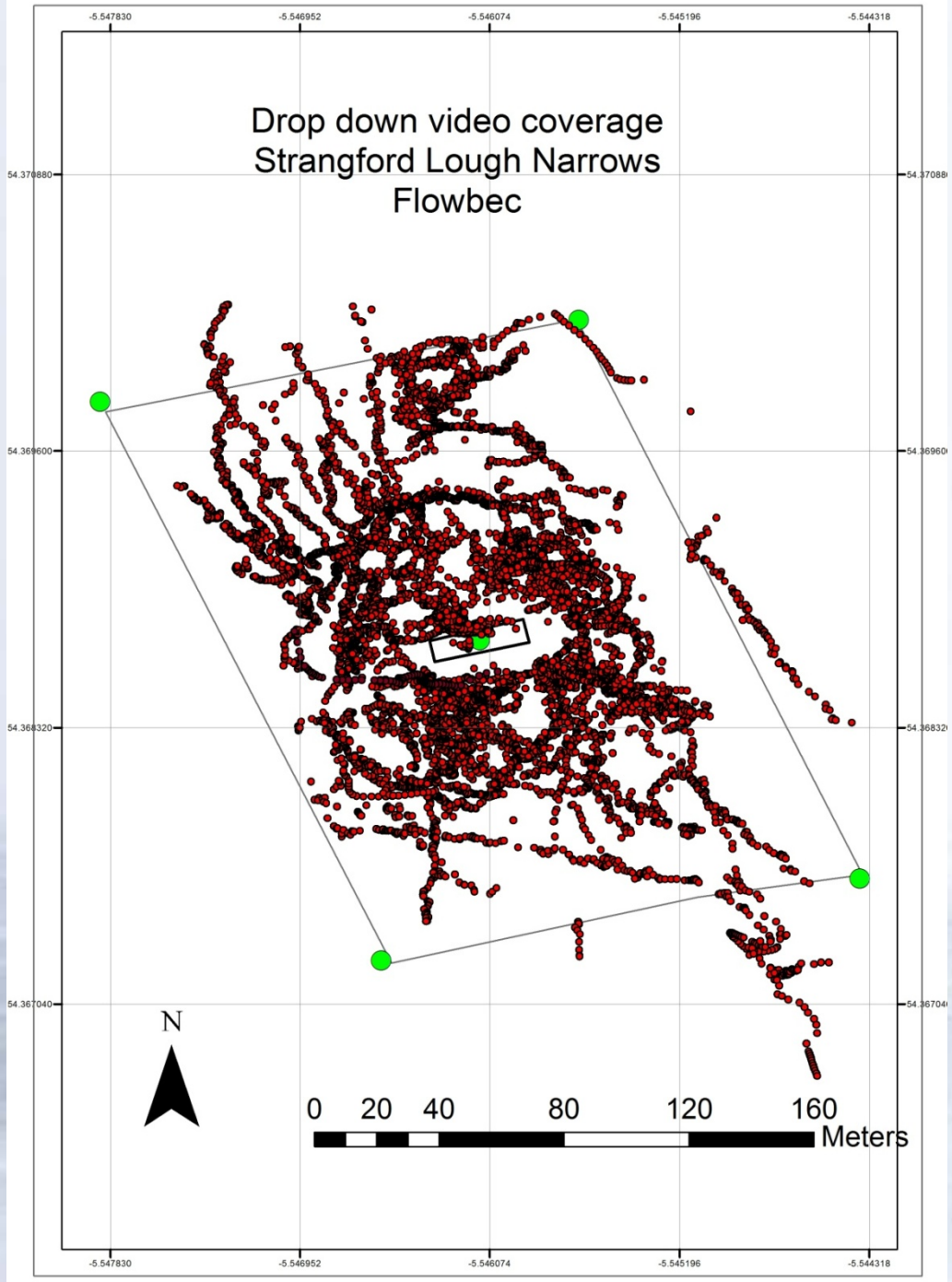


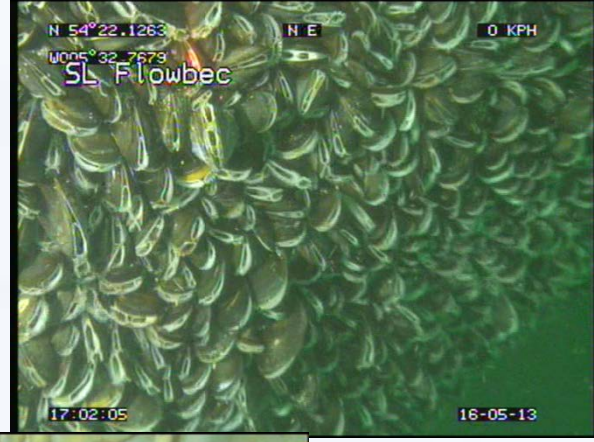
Strangford Lough

- **Drop down video surveys of benthic environment – see Jack O'Carroll's poster**

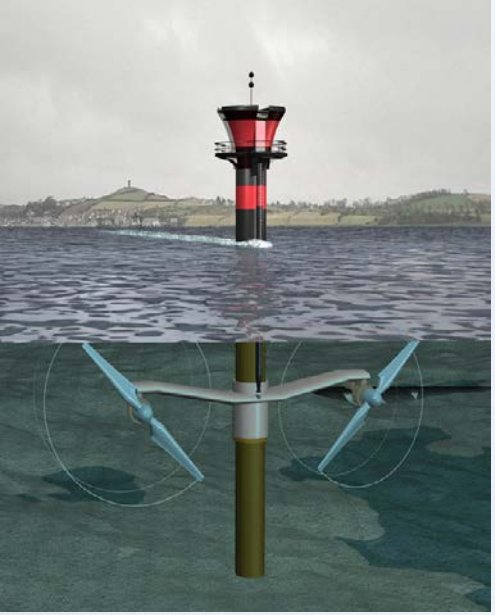
- **CFD modelling of turbine wake – Angus Creech, U. Edinburgh**

- **Investigate association between turbulent wake and spatial variability in benthos**



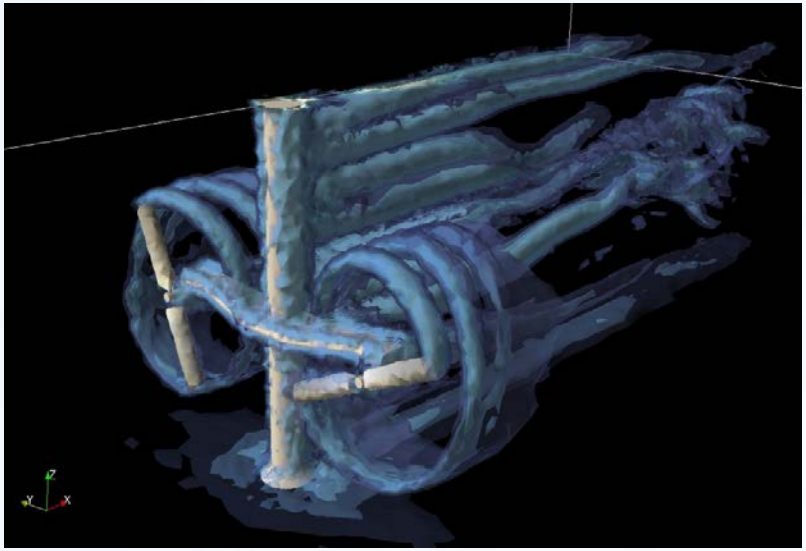


Images – Bob Kennedy & Jack O'Carroll

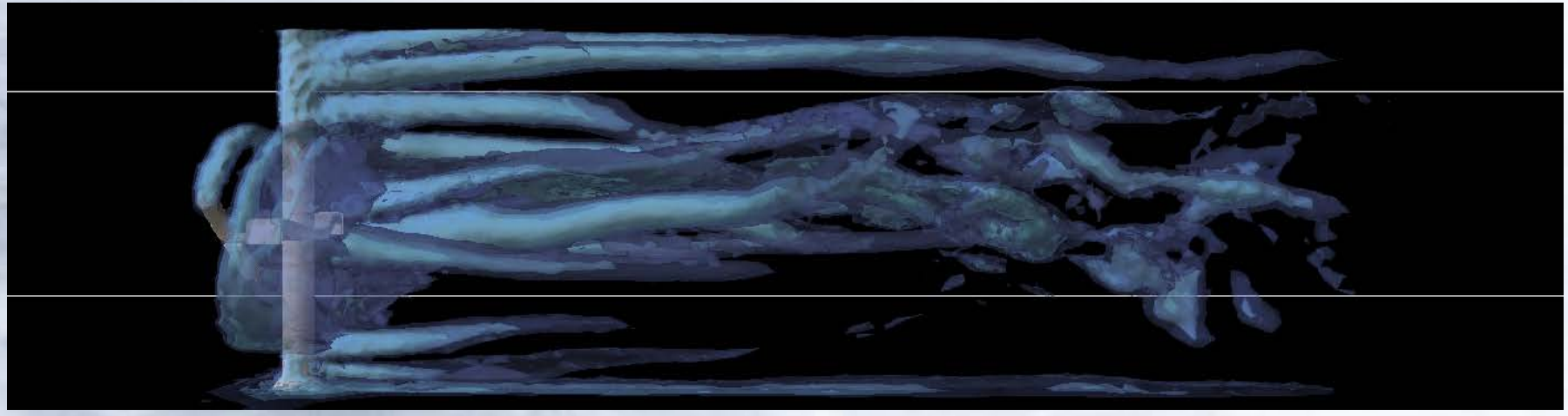


- Actuator line-modelled rotors and solid supporting structure
- Two contra-rotating rotors
- Based upon Seagen device operating in Strangford Lough
- Additional turbulence generated by structure

Images by
Angus Creech
U. Edinburgh



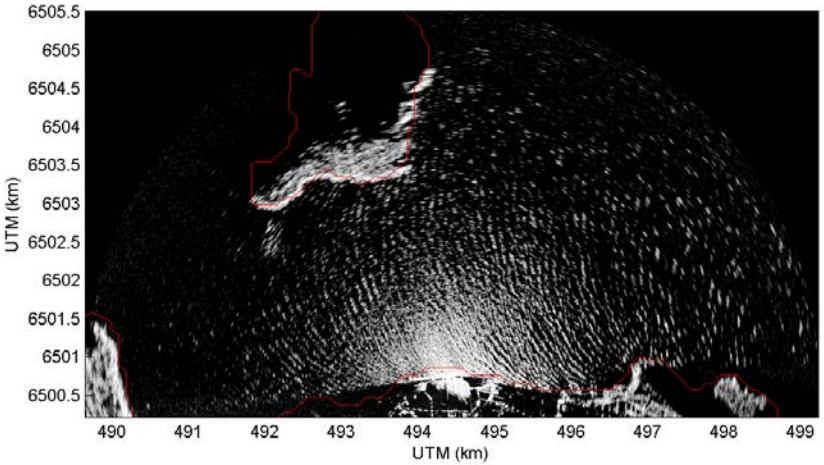
- Tip vortices and vortex sheets generated
- Also from tower / beam structure

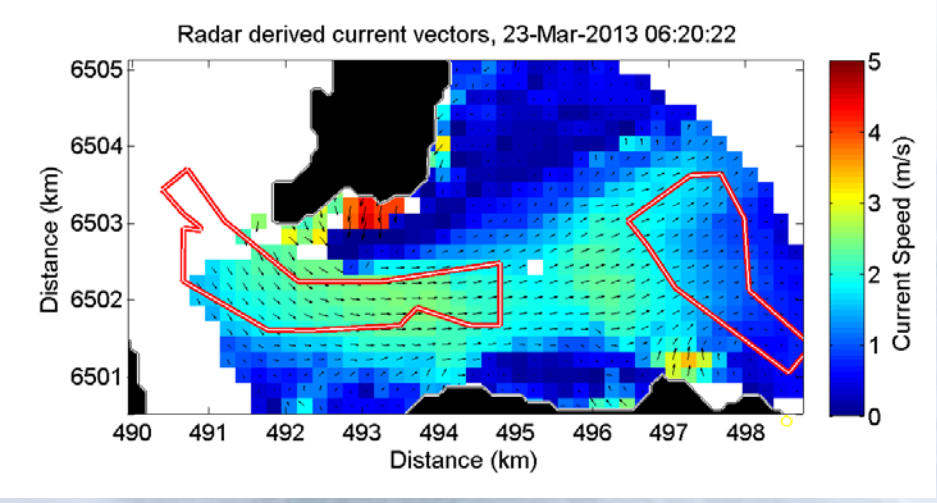


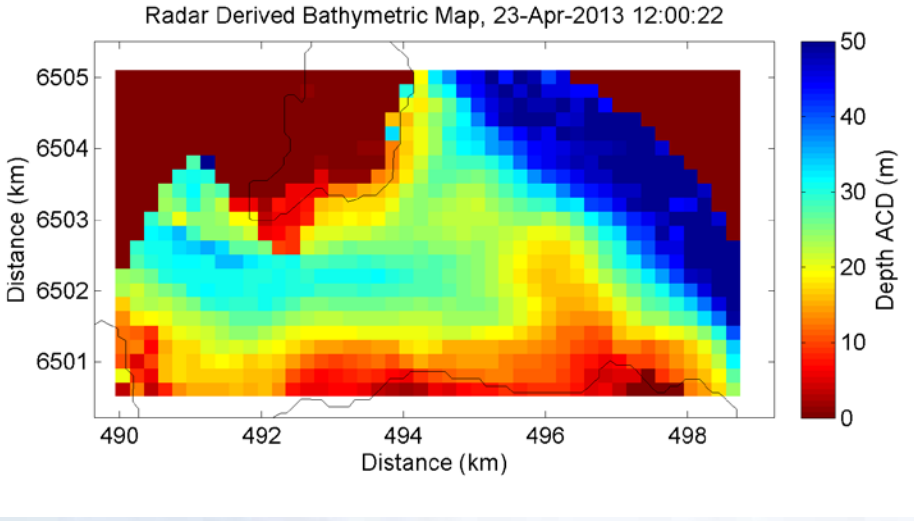
PentlandX – Radar deployments at Meygen site

Demonstration at Meygen Ltd planned tidal turbine array site, Inner Sound of Stroma in the Pentland Firth

Paul Bell & David McCann,
NOC Liverpool







Acknowledgements

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- **OpenHydro, Atlantis Resources Corporation**
- **Imaginex, Hydro Products**
- **NOC:** Colin Bell, Applications Group (POLPRED) & Russell Wynn, MAREMAP Project
- Many many others!

E-mail: psb@noc.ac.uk

Project Web Site: noc.ac.uk/project/flowbec